PBEEEP
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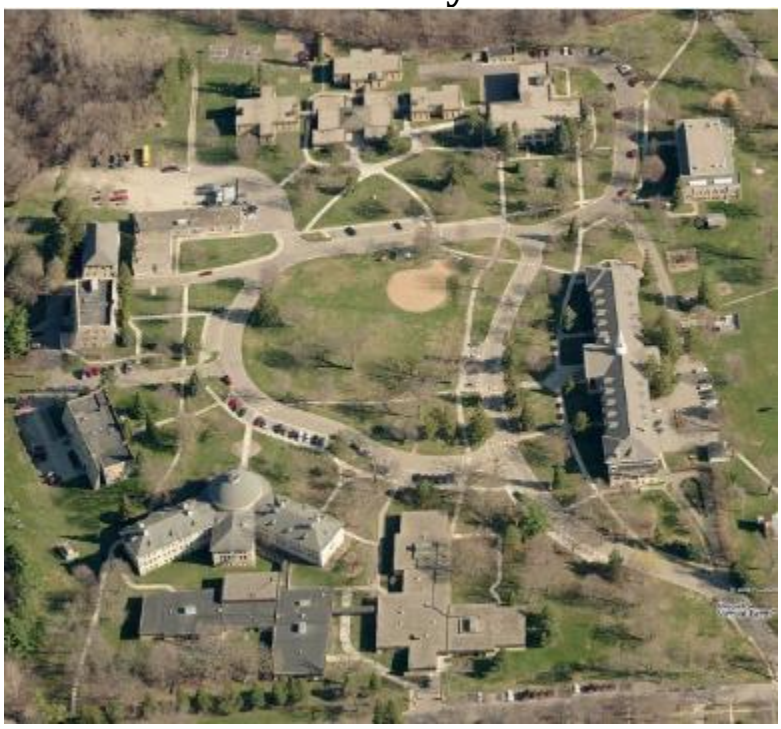
Public Buildings Enhanced Energy Efficiency Program

Final Report
Investigation Results For
Minnesota Academy for the Deaf



Date: 6/20/2012

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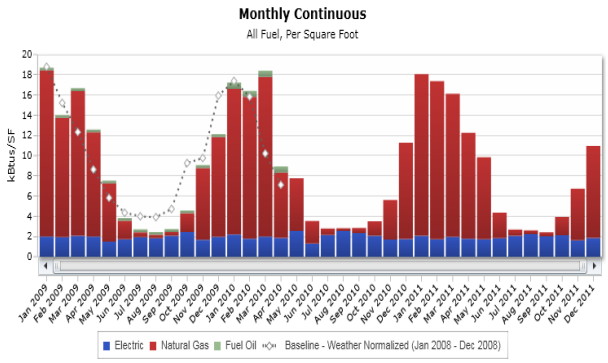
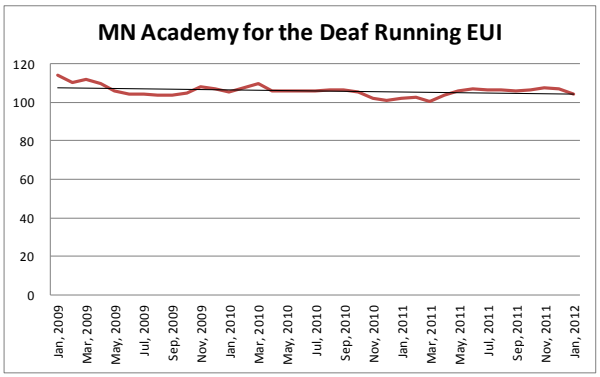
Minnesota Academy for the Deaf Energy Investigation Overview

The goal of a PBEEEP Energy Investigation is to identify energy savings opportunities with a payback of fifteen years or less. Particular emphasis is on finding those opportunities that will generate savings with a relatively fast (1 to 5 years) and certain payback. During the investigation phase the provider conducts a rigorous analysis of the building operations. Through observation, targeted functional testing, and analysis of extensive trend and portable logger data, the RCx Provider identifies deficiencies in the operation of the mechanical equipment, lighting, envelope, and related controls. The investigation of Minnesota Academy for the Deaf was performed by Hammel, Green and Abrahamson, Inc. This report is the result of that information.

Payback Information and Energy Savings				
Total project costs (Without Co-funding)			**Project costs with Co-funding**	
Total costs to date including study	$36,726		Total Project Cost	$45,756
Future costs including Implementation , Measurement & Verification	$9,030		Study and Administrative Cost Paid with ARRA Funds	($39,726)
Total Project Cost	$45,756		Utility Co-funding	($0)
			Total costs after co-funding	$6,030
Estimated Annual Total Savings ($)	$6,361		Estimated Annual Total Savings ($)	$6,361
Total Project Payback	7.2		Total Project Payback with co-funding	0.9
Electric Energy Savings	**4.4%**	**and**	**Natural Gas Savings**	**0.4 %**





Minnesota Academy for the Deaf Consumption Report
Total energy use was constant during the period of the investigation

Year	Days	SF	Total kBtu	Normalized Baseline kBtu	Change from Baseline kBtu	% Change	Total Energy Cost $	Average Cost Rate $ /kBtu
2009	365	276,153	29,536,282	31,142,875	-1,606,593	-5%	$282,792.54	$0.01
2010	365	276,153	27,914,817	29,073,527	-1,158,711	-4%	$264,718.83	$0.01
2011	365	276,153	29,618,342	27,983,366	1,634,976	6%	$281,997.59	$0.01

STATE OF MINNESOTA B3 BENCHMARKING

Summary Tables

Minnesota Academy for the Deaf	
Location	615 Olof Hanson Drive, Faribault, MN 55021
Facility Manager	Randy Dirks
State's Project Manager	Peter Hargreaves
Interior Square Footage	276,153 total; 83,888 to be investigated
PBEEEP Provider	Hammel, Green and Abrahamson, Inc.
Annual Energy Cost	$ 281,998 (2011) Source: B3
Utility Company	Xcel Energy (electric and gas)
Site Energy Use Index (EUI)	105 kBtu/ft^2 (at start of study) 106 kBtu/ft^2 (at end of study)
Benchmark EUI (from B3)	114 kBtu/ft^2

Building Name	State ID	Area (Square Feet)	Year Built
Smith Hall	E4400101966	25,341	1973
Quinn Hall	E4400102166	22,175	1971
Mott Hall	E4400102866	13,769	1926
Rodman Hall	E4400101766	22,603	1923

Mechanical Equipment Summary Table (of buildings included in the investigation)	
Quantity	**Equipment Description**
1	Building Automation Systems (Honeywell and Johnson Controls)
83,888	Square Feet
3	Chillers
6	Air Handlers
1	ERU
11	CUH
44	VAV Boxes
29	EF
10	Fan Coil Units
6	Chilled water Pumps
4	Hot Water Pumps
200	Approximate number of points to trend

Implementation Information			
Estimated Annual Total Savings ($)			$6,361
Total Estimated Implementation Cost ($)			$6,030
GHG Avoided in U.S Tons (CO2e)			76
Electric Energy Savings (kWh) 2011 Electric Usage 1,861,955 kWh (from B3)	4.4 % Savings		82,535
Electric Demand Savings (Peak kW) 2011 Peak Demand 720 kW (from B3)	2.5 % Savings		18
Natural Gas Savings 2011 Natural Gas Usage 232,654 Therms (from B3)	0.4% Savings		1,020
Statistics			
Number of Measures identified			10
Number of Measures with payback < 3 years			7
Screening Start Date	1/30/2010	Screening End Date	4/7/2010
Investigation Start Date	10/26/2011	Investigation End Date	4/28/2012
Final Report	6/20/2012		

Minnesota Academy for the Deaf Cost Information			
Phase		**To date**	**Estimated**
Screening		$7,946	
Investigation [Provider]		$24,990	
Investigation [CEE]		$3,790	$1,000
Implementation			$6,030
Implementation [CEE]			$1,000
Measurement & Verification		0	$1,000
Total		$36,726	$9,030

Co-funding Summary	
Study and Administrative Cost	$39,716
Utility Co-Funding - Estimated Total ($)	$0
Total Co-funding ($)	$39,716

Facility Overview

The energy investigation included 30% of the building area at the Minnesota Academy for the Deaf. The space area was limited because of the lack of a building automation system in most of the buildings which makes the gathering of building operation data expensive and does not allow for the implementation of control strategies. The study identified 1.3 % of total energy savings at Minnesota Academy for the Deaf with measures that payback in less than 15 years and do not adversely affect occupant comfort. The energy savings opportunities identified at Minnesota Academy for the Deaf are based on correcting equipment schedules to correspond to actual periods of building use, adjusting static pressure setpoints and improving economizer operations. The total cost of implementing all the measures is $6,030.

Implementing all these measures can save the college approximately $6,361 a year with a combined payback period of 1 year before rebates based on the implementation cost only (excluding study and administrative costs). These measures will produce 4.4% electrical savings and 0.4% natural gas savings. The building is currently performing at 6% below the Minnesota Benchmarking and Beyond database (B3) benchmark.

The primary energy intensive systems at Minnesota Academy for the Deaf are described here:

The Minnesota Academies Deaf Campus is made up of 13 buildings totaling 276,153 gross square feet. The buildings were all constructed between 1909 and 1973. There have been several mechanical upgrades during the history of the facility.

Mechanical Equipment

The Power Plant boilers supply heat to the whole campus. Areas of all the building which do not receive heat directly from the AHUs are primarily heated by finned tube radiation. The steam is generated by the Power Plant on campus.

Controls and Trending

The buildings to be investigated, Smith, Quinn, Mott and Rodman, which total 83,888 ft2, are either fully automated or almost completely automated on a Talon system by Siemens. The system is capable of trending. Most of the other buildings are not on the automation system.

Lighting

Most of the buildings contain T8 lights.

Energy Use Index and B3 Benchmark

The site Energy Use Index (EUI) for all buildings is 107 kBtu/sq ft, which is 6% lower than their B3 Benchmark of 114 kBtu/sq ft. The median site EUI for State of Minnesota buildings are 23% lower than their corresponding B3 Benchmarks.

Metering

There are three electric meters and two gas meters.

Findings Summary

Site: MN Academy of the Deaf Completion

Eco #	Building	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	Mott Hall	All Fan Coil Units currently operate M-F although building is mostly unoccupied.	$250	$1,626	0.15	$0	0.15	19
2	Mott Hall	All Fan Coil units operate on schedule although campus is unoccupied during summer breaks	$250	$1,053	0.24	$0	0.24	7
2	Quinn Hall	AHU-1 and AHU-2 operate during nights and weekends	$600	$1,740	0.34	$0	0.34	31
1	Smith Hall	All equipment operates year round.	$100	$197	0.51	$0	0.51	3
3	Rodman Hall	FCU-2 operates during summer breaks. Schedule OFF when Rodman is not occupied in summer.	$100	$112	0.89	$0	0.89	1
3	Quinn Hall	AHU-1 operate during summer months when campus is unoccupied	$600	$474	1.26	$0	1.26	2
2	Rodman Hall	ERU-1 operates during summer breaks. Schedule OFF during summer except for 2 weeks during summer sc	$840	$446	1.88	$0	1.88	3
1	Rodman Hall	ERU-1 operates 7 days a week. Schedule OFF during weekends.	$840	$217	3.87	$0	3.87	4
1	Quinn Hall	AHU-1 and AHU-2 Static Pressure setpoint	$2,350	$482	4.87	$0	4.87	6
4	Quinn Hall	Economizer operation at AHU-1	$100	$14	6.94	$0	6.94	0
		Total for Findings with Payback 3 years or less:	**$2,740**	**$5,647**	**0.49**	**$0**	**0.49**	**66**
		Total for all Findings:	**$6,030**	**$6,361**	**0.95**	**$0**	**0.95**	**76**

Finding Type Number	Finding Type	Relevant Findings	Looked for, not found	Not relevant
a.1 (1)	Time of Day enabling is excessive	2	2	
a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	4		
a.3 (3)	Lighting is on more hours than necessary.		1	3
a.4 (4)	OTHER_Equipment Scheduling/Enabling	1	3	
b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or	1	2	1
b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air		4	
b.3 (7)	OTHER_Economizer/OA Loads		3	
c.1 (8)	Simultaneous Heating and Cooling is present and excessive		4	
c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement		4	
c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints	1	1	1
c.4 (11)	OTHER_Controls	1	2	
d.1 (12)	Daylighting controls or occupancy sensors need optimization.			4
d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.		3	1
d.3 (14)	Fan Speed Doesn't Vary Sufficiently		4	
d.4 (15)	Pump Speed Doesn't Vary Sufficiently			4
d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary	1	1	2
d.6 (17)	Other_Controls (Setpoint Changes)		2	1
e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal		1	3
e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal		1	3
e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal		1	2
e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal	1	1	2

e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal		2	2
e.6 (22)	Other_Controls (Reset Schedules)		3	1
f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit		1	3
f.2 (24)	Pump Discharge Throttled		2	2
f.3 (25)	Over-Pumping		2	2
f.4 (26)	Equipment is oversized for load.		2	2
f.5 (27)	OTHER_Equipment Efficiency/Load Reduction		2	2
g.1 (28)	VFD Retrofit - Fans			4
g.2 (29)	VFD Retrofit - Pumps			4
g.3 (30)	VFD Retrofit - Motors (process)			4
g.4 (31)	OTHER_VFD			4
h.1 (32)	Retrofit - Motors			4
h.2 (33)	Retrofit - Chillers			4
h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)			3
h.4 (35)	Retrofit - Boilers			4
h.5 (36)	Retrofit - Packaged Gas fired heating			4
h.6 (37)	Retrofit - Heat Pumps			4
h.7 (38)	Retrofit - Equipment (custom)			4
h.8 (39)	Retrofit - Pumping distribution method			4
h.9 (40)	Retrofit - Energy/Heat Recovery			4
h.10 (41)	Retrofit - System (custom)			4
h.11 (42)	Retrofit - Efficient Lighting			4
h.12 (43)	Retrofit - Building Envelope			4
h.13 (44)	Retrofit - Alternative Energy			4
h.14 (45)	OTHER_Retrofit			4
i.1 (46)	Differed Maintenance from Recommended/Standard			4

i.2 (47)	Impurity/Contamination			4
i.3 ( )	Leaky/Stuck Damper		1	3
i.4 ( )	Leaky/Stuck Valve		1	3
i.5 (48)	OTHER_Maintenance		1	3
j.1 (49)	OTHER		1	3

Findings Glossary: Findings Examples

a.1 (1)	**Time of Day enabling is excessive**
	• HVAC running when building is unoccupied. Equipment schedule doesn't follow building occupancy • Optimum start-stop is not implemented • Controls in hand
a.2 (2)	**Equipment is enabled regardless of need, or such enabling is excessive**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating
a.3 (3)	**Lighting is on more hours than necessary**
	• Lighting is on at night when the building is unoccupied • Photocells could be used to control exterior lighting • Lighting controls not calibrated/adjusted properly
a.4 (4)	**OTHER Equipment Scheduling and Enabling**
	• Please contact PBEEEP Project Engineer for approval
b.1 (5)	**Economizer Operation – Inadequate Free Cooling**
	• Economizer is locked out whenever mechanical cooling is enabled (non-integrated economizer) • Economizer linkage is broken • Economizer setpoints could be optimized • Plywood used as the outdoor air control • Damper failed in minimum or closed position
b.2 (6)	**Over-Ventilation**
	• Demand-based ventilation control has been disabled • Outside air damper failed in an open position • Minimum outside air fraction not set to design specifications or occupancy
b.3 (7)	**OTHER Economizer/Outside Air Loads**
	• Please contact PBEEEP Project Engineer for approval
c.1 (8)	**Simultaneous Heating and Cooling is present and excessive**
	• For a given zone, CHW and HW systems are unnecessarily on and running simultaneously • Different setpoints are used for two systems serving a common zone
c.2 (9)	**Sensor / Thermostat needs calibration, relocation / shielding, and/or replacement**
	• OAT temperature is reading 5 degrees high, resulting in loss of useful economizer operation • Zone sensors need to be relocated after tenant improvements • OAT sensor reads high in sunlight
c.3 (10)	**Controls "hunt" / need Loop Tuning or separation of heating/cooling setpoints**
	• CHW valve cycles open and closed • System needs loop tuning – it is cycling between heating and cooling
c.4 (11)	**OTHER Controls**
	• Please contact PBEEEP Project Engineer for approval
d.1 (12)	**Daylighting controls or occupancy sensors need optimization**
	• Existing controls are not functioning or overridden • Light sensors improperly placed or out of calibration
d.2 (13)	**Zone setpoint setup / setback are not implemented or are sub-optimal**
	• The cooling setpoint is 74 ºF 24 hours per day
d.3 (14)	**Fan Speed Doesn't Vary Sufficiently**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating

d.4 (15)	**Pump Speed Doesn't Vary Sufficiently**
	• Pump runs at 15 PSI on peak day. Lowering pressure to 12 does not create comfort problem and the flow is per design. Low ΔT across the chiller during low load conditions.
d.5 (16)	**VAV Box Minimum Flow Setpoint is higher than necessary**
	• Boxes universally set at 40%, regardless of occupancy. Most boxes can have setpoints lowered and still meet minimum airflow requirements.
d.6 (17)	**Other Controls (Setpoint Changes)**
	• Please contact PBEEEP Project Engineer for approval
e.1 (18)	**HW Supply Temperature Reset is not implemented or is sub-optimal**
	• HW supply temperature is a constant 180 ºF. It should be reset based on demand, or decreased by a reset schedule as OAT increases. • DHW Setpoints are constant 24 hours per day
e.2 (19)	**CHW Supply Temperature Reset is not implemented or is sub-optimal**
	• CHW supply temperature is a constant 42 ºF. It could be reset, based on demand or ambient temperature.
e.3 (20)	**Supply Air Temperature Reset is not implemented or is sub-optimal**
	• The SAT is constant at 55 ºF. It could be reset to minimize reheat and maximize economizer cooling. The reset should ideally be based on demand (e.g., looking at zone box damper positions), but could also be reset based on OAT.
e.4 ( )	**Supply Duct Static Pressure Reset is not implemented or is suboptimal**
	• The Duct Static Pressure (DSP) is constant at 1.5" wc. It could be reset to minimize fan energy. The reset should ideally be based on demand (e.g. looking at zone box damper positions), but could also be reset based on OAT.
e.5 (21)	**Condenser Water Temperature Reset is not implemented or is sub-optimal**
	• CW temperature is constant leaving the tower at 85 ºF. The temperature should be reduced to minimize the total energy use of the chiller and tower. It may be worthwhile to reset based on load and ambient conditions.
e.6 (22)	**Other Controls (Reset Schedules)**
	• Please contact PBEEEP Project Engineer for approval
f.1 (23)	**Lighting system needs optimization - Spaces are overlit**
	• Lighting exceeds ASHRAE or IES standard levels for specific space types or tasks
f.2 (24)	**Pump Discharge Throttled**
	• The discharge valve for the CHW pump is 30% open. The valve should be opened and the impeller size reduced to provide the proper flow without throttling.
f.3 (25)	**Over-Pumping**
	• Only one CHW pump runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
f.4 (26)	**Equipment is oversized for load**
	• The equipment cycles unnecessarily • The peak load is much less than the installed equipment capacity

f.5 (27)	**OTHER Equipment Efficiency/Load Reduction**
	• Please contact PBEEEP Project Engineer for approval
g.1 (28)	**VFD Retrofit Fans**
	• Fan serves variable flow system, but does not have a VFD. • VFD is in override mode, and was found to be not modulating.
g.2 (29)	**VFD Retrofit - Pumps**
	• 3-way valves are used to maintain constant flow during low load periods. • Only one CHW pumps runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
g.3 (30)	**VFD Retrofit - Motors (process)**
	• Motor is constant speed and uses a variable pitch sheave to obtain speed control.
g.4 (31)	**OTHER VFD**
	• Please contact PBEEEP Project Engineer for approval
h.1 (32)	**Retrofit - Motors**
	• Efficiency of installed motor is much lower than efficiency of currently available motors
h.2 (33)	**Retrofit - Chillers**
	• Efficiency of installed chiller is much lower than efficiency of currently available chillers
h.3 (34)	**Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)**
	• Efficiency of installed air conditioner is much lower than efficiency of currently available air conditioners
h.4 (35)	**Retrofit - Boilers**
	• Efficiency of installed boiler is much lower than efficiency of currently available boilers
h.5 (36)	**Retrofit - Packaged Gas-fired heating**
	• Efficiency of installed heaters is much lower than efficiency of currently available heaters
h.6 (37)	**Retrofit - Heat Pumps**
	• Efficiency of installed heat pump is much lower than efficiency of currently available heat pumps
h.7 (38)	**Retrofit - Equipment (custom)**
	• Efficiency of installed equipment is much lower than efficiency of currently available equipment
h.8 (39)	**Retrofit - Pumping distribution method**
	• Current pumping distribution system is inefficient, and could be optimized. • Pump distribution loop can be converted from primary to primary-secondary)
h.9 (40)	**Retrofit - Energy / Heat Recovery**
	• Energy is not recouped from the exhaust air. • Identification of equipment with higher effectiveness than the current equipment.
h.10 (41)	**Retrofit - System (custom)**
	• Efficiency of installed system is much lower than efficiency of another type of system
h.11 (42)	**Retrofit - Efficient lighting**
	• Efficiency of installed lamps, ballasts or fixtures are much lower than efficiency of currently available lamps, ballasts or fixtures.

h.12 (43)	**Retrofit - Building Envelope**
	• Insulation is missing or insufficient • Window glazing is inadequate • Too much air leakage into / out of the building • Mechanical systems operate during unoccupied periods in extreme weather
h.13 (44)	**Retrofit - Alternative Energy**
	• Alternative energy strategies, such as passive/active solar, wind, ground sheltered construction or other alternative, can be incorporated into the building design
h.14 (45)	**OTHER Retrofit**
	• Please contact PBEEEP Project Engineer for approval
i.1 (46)	**Differed Maintenance from Recommended/Standard**
	• Differed maintenance that results in sub-optimal energy performance. • Examples: Scale buildup on heat exchanger, broken linkages to control actuator missing equipment components, etc.
i.2 (47)	**Impurity/Contamination**
	• Impurities or contamination of operating fluids that result in sub-optimal performance. Examples include lack of chemical treatment to hot/cold water systems that result in elevated levels of TDS which affect energy efficiency.
i.3 ( )	**Leaky/Stuck Damper**
	• The outside or return air damper on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.4 ( )	**Leaky/Stuck Valve**
	• The heating or cooling coil valve on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.5 (48)	**OTHER Maintenance**
	• Please contact PBEEEP Project Engineer for approval
j.1 (49)	**OTHER**
	• Please contact PBEEEP Project Engineer for approval

Findings Summary

Building: Smith Hall

Site: MN Academy of the Deaf Completion

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	All equipment operates year round.	$100	$197	0.51	$0	0.51	3
	Total for Findings with Payback 3 years or less:	**$100**	**$197**	**0.51**	**$0**	**0.51**	**3**
	Total for all Findings:	**$100**	**$197**	**0.51**	**$0**	**0.51**	**3**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Smith Hall

FWB Number:	10931	Eco Number:	1
Site:	MN Academy of the Deaf Completion	Date/Time Created:	6/12/2012

Investigation Finding:	All equipment operates year round.	Date Identified:	2/20/2012
Description of Finding:	Equipment schedules match school year schedules in summer although students on campus only two weeks in July. Run AHUs and EFs only at night for 2 hours to maintain humidity levels.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Equipment is enabled regardless of need, or such enabling is excessive		

Implementer:	Building Operator	Benefits:	Energy Savings
Baseline Documentation Method:	Trended fan speeds, DAT at AHUs, VAV box cfms, space temperatures. Schedule verified at BAS.		
Measure:	During summer vacation turn off all AHUs and EFs except for 2 hours per night and 2 weeks for scheduled summer school.		
Recommendation for Implementation:	AHU-3, AHU-5, EF-1, EF-2, EF-3, EF-4, EF-5, EF-6, and EF-7 should be scheduled off during the summer secession. The AHUs should turn of for two hours a day to air out the space and dehumidify the air if needed. The schedule should be altered by facility staff every year to assure the units will follow this schedule during the summer secession.		
Evidence of Implementation Method:	The following points will be trended on the AHUs. SF status, SF speed, OA damper, MAT, RAT, OAT, heat valve and chilled water valve. The EF status will be monitored as well.		

Annual Electric Savings (kWh):	3,403	Contractor Cost ($):	$100
Estimated Annual kWh Savings ($):	$197	PBEEEP Provider Cost for Implementation Assistance ($):	$0
		Total Estimated Implementation Cost ($):	$100

Estimated Annual Total Savings ($):	$197	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.51	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.51	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	3	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	2.7%	Percent of Implementation Costs:	1.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Summary

Building: Quinn Hall

Site: MN Academy of the Deaf Completion

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
2	AHU-1 and AHU-2 operate during nights and weekends	$600	$1,740	0.34	$0	0.34	31
3	AHU-1 operate during summer months when campus is unoccupied	$600	$474	1.26	$0	1.26	2
1	AHU-1 and AHU-2 Static Pressure setpoint	$2,350	$482	4.87	$0	4.87	6
4	Economizer operation at AHU-1	$100	$14	6.94	$0	6.94	0
	Total for Findings with Payback 3 years or less:	**$1,200**	**$2,214**	**0.54**	**$0**	**0.54**	**33**
	Total for all Findings:	**$3,650**	**$2,711**	**1.35**	**$0**	**1.35**	**39**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Quinn Hall

FWB Number:	10932	Eco Number:	1
Site:	MN Academy of the Deaf Completion	Date/Time Created:	6/12/2012

Investigation Finding:	AHU-1 and AHU-2 Static Pressure setpoint	Date Identified:	2/20/2012
Description of Finding:	Both AHU-1 and AHU-2 VFD modulates to maintain 2.0" static pressure setpoint in duct. VAV boxes always meet cfm setpoint. Fan speed rarely exceeds 90% even on design day.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Reset Schedules)
Finding Type:	Supply Duct Static Pressure Reset is not implemented or is sub-optimal		

Implementer:	Operator, controls contractor	Benefits:	Energy savings
Baseline Documentation Method:	Trends of duct DP setpoint, VFD speed, VAV cfm setpoints and VAV cfm actual.		
Measure:	Implement duct static pressure reset program.		
Recommendation for Implementation:	A control contractor will program to unit Reset duct DP setpoint on AHU-1 and AHU-2 to 1.0". The duct static setpoint for the unit will automatically reset to 1.5" if any of the VAV CFMs cannot be met. Once they are all met, the limit will be set back to 1.0"		
Evidence of Implementation Method:	The following points will have to be trended on AHU-1 and AHU-2: RAT, DAT, Heat Valve, Supply duct static, SF status and SF speed. The following points will be trended for just AHU-1: Economizer dampers, cooling valve, EF status, EF speed, and MAT. All VAV space temperatures and CFM and CFM setpoints need to be trended as well to assure they are meeting space temperature and CFM setpoints with the reduced duct static pressure. These points will be trended for a two week period when it is below 20 F outside in the winter and above 75 F in the summer.		

Annual Electric Savings (kWh):	7,347	Contractor Cost ($):	$1,850
Estimated Annual kWh Savings ($):	$482	PBEEEP Provider Cost for Implementation Assistance ($):	$500
		Total Estimated Implementation Cost ($):	$2,350

Estimated Annual Total Savings ($):	$482	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	4.87	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	4.87	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	6	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	6.6%	Percent of Implementation Costs:	23.5%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Quinn Hall

FWB Number:	10932	Eco Number:	2
Site:	MN Academy of the Deaf Completion	Date/Time Created:	6/12/2012

Investigation Finding:	AHU-1 and AHU-2 operate during nights and weekends	Date Identified:	2/20/2012
Description of Finding:	AHU-1 and AHU-2 have occupancy schedules, but instead of shutting off reduce the speed to 50% during unoccupied times.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Equipment is enabled regardless of need, or such enabling is excessive		

Implementer:	Operator	Benefits:	Energy Savings
Baseline Documentation Method:	Trend of VFD speed, DAT, cooling and heating valves		
Measure:	Use existing schedule to turn off units when building is not occupied		
Recommendation for Implementation:	AHU-1 and AHU-2 will be scheduled to run from 6 AM to 3 PM Monday through Friday and turn off the remaining hours. During unoccupied times if the space temperature deviates from the unoccupied setpoint, the unit will turn on and modulate the valve with the OA damper shut to maintain setpoint.		
Evidence of Implementation Method:	The following points will have to be trended on AHU-1 and AHU-2: RAT, DAT, Heat Valve, Supply duct static, SF status and SF speed. The following points will be trended for just AHU-1: Economizer dampers, cooling valve, EF status, EF speed, and MAT. These points will assure the unit is operating as specified during unoccupied times. The chilled water pumps status will be trended as well to assure they are off when the AHUs are off.		

Annual Electric Savings (kWh):	32,160	Annual Natural Gas Savings (therms):	553
Estimated Annual kWh Savings ($):	$1,360	Estimated Annual Natural Gas Savings ($):	$379
Contractor Cost ($):	$100		
PBEEEP Provider Cost for Implementation Assistance ($):	$500		
Total Estimated Implementation Cost ($):	$600		

Estimated Annual Total Savings ($):	$1,740	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.34	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.34	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	31	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	23.9%	Percent of Implementation Costs:	6.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Quinn Hall

FWB Number:	10932	Eco Number:	3
Site:	MN Academy of the Deaf Completion	Date/Time Created:	6/12/2012

Investigation Finding:	AHU-1 operate during summer months when campus is unoccupied	Date Identified:	2/20/2012
Description of Finding:	Campus is empty except for 2 weeks during July for summer school. Units continue to operate daily. Will reduce peak demand during July.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Equipment is enabled regardless of need, or such enabling is excessive		

Implementer:	Operator	Benefits:	Energy savings
Baseline Documentation Method:	Trend of VFD speed, DAT, cooling and heating valves		
Measure:	Use existing schedule to turn off units when building is not occupied		
Recommendation for Implementation:	AHU-1 will be scheduled off during the summer break. It will turn on 2 hours a day with AHU-2 to assure ventilation will be provided to the space and to help maintain the humidity levels. When the AHUs are off the chilled water pumps will remain off as well. Currently the chilled water pumps are initiating when the OAT is above 60 F at all times. During unoccupied times if the space temperature rises above unoccupied setpoint, the unit will initiate on.		
Evidence of Implementation Method:	The following points will have to be trended on AHU-1 and AHU-2: RAT, DAT, Heat Valve, Supply duct static, SF status and SF speed. The following points will be trended for just AHU-1: Economizer dampers, cooling valve, EF status, EF speed, and MAT. These points will assure the unit is operating as specified during unoccupied times. The chilled water pumps status will be trended as well to assure they are off when the AHUs are off.		

Annual Electric Savings (kWh):	2,425	Contractor Cost ($):	$100
Estimated Annual kWh Savings ($):	$169	PBEEEP Provider Cost for Implementation Assistance ($):	$500
		Total Estimated Implementation Cost ($):	$600

Estimated Annual Total Savings ($):	$474	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	1.26	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	1.26	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	2	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	6.5%	Percent of Implementation Costs:	6.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Quinn Hall

FWB Number:	10932	Eco Number:	4
Site:	MN Academy of the Deaf Completion	Date/Time Created:	6/12/2012

Investigation Finding:	Economizer operation at AHU-1	Date Identified:	2/20/2012
Description of Finding:	Economizer setpoint is MAT=64. Discharge air temperature setopint is 60. Chilled water valve is modulating to cool MAT to 60 when OA could be used. The chiller is only available when OAT=>62F so the energy savings apply only to those hours when OAT is between 62 or 63F, so savings is very low but valve modulation could be avoided.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Economizer/Outside Air Loads
Finding Type:	Other Economizer/OA Loads		

Implementer:	Operator	Benefits:	Energy savings, valve hunting
Baseline Documentation Method:	Trended AHU temperatures, cooling valve percent trended, setpoints within BAS logic.		
Measure:	Change MAT setpoint for economizer to 60F to match DAT setpoint.		
Recommendation for Implementation:	Change economizer setpoint at AHU-1 to 60F.		
Evidence of Implementation Method:	The cooling valve, OA damper, RAT, MAT, DAT, and OAT will be trended for a two week period when the OAT is between 60 and 70 F to assure the economizer is operating properly.		

Annual Electric Savings (kWh):	207	Contractor Cost ($):	$100
Estimated Annual kWh Savings ($):	$14	PBEEEP Provider Cost for Implementation Assistance ($):	$0
		Total Estimated Implementation Cost ($):	$100

Estimated Annual Total Savings ($):	$14	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	6.94	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	6.94	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.2%	Percent of Implementation Costs:	1.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Summary

Building: Mott Hall

Site: MN Academy of the Deaf Completion

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
1	All Fan Coil Units currently operate M-F although building is mostly unoccupied.	$250	$1,626	0.15	$0	0.15	19
2	All Fan Coil units operate on schedule although campus is unoccupied during summer breaks	$250	$1,053	0.24	$0	0.24	7
	Total for Findings with Payback 3 years or less:	**$500**	**$2,679**	**0.19**	**$0**	**0.19**	**26**
	Total for all Findings:	**$500**	**$2,679**	**0.19**	**$0**	**0.19**	**26**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Mott Hall

FWB Number:	10933	Eco Number:	1
Site:	MN Academy of the Deaf Completion	Date/Time Created:	6/12/2012

Investigation Finding:	All Fan Coil Units currently operate M-F although building is mostly unoccupied.	Date Identified:	2/20/2012
Description of Finding:	There are 8 FCUs within this building and the building is largely unoccupied. There is only one class in the complex which runs from 7 AM to 10 AM Monday through Friday. The remaining part of the building is unoccupied because the equipment which the classes use has been determined to be outdated and not safe. Even though the building is largely unoccupied the units run to assure humidity levels don't get too high. Scheduling FCU-1, 2, 3, 4, 5, 6, 7, and 8 at reduced times will save energy and still help maintain proper humidity levels in the space. When the FCUs are off the chilled water pumps which distribute chilled water to them can be off as well.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Equipment is enabled regardless of need, or such enabling is excessive		

Implementer:	Operator	Benefits:	Energy Savings
Baseline Documentation Method:	Trended data for 3 of 8 FCUs. Schedules observed on BAS for remainder of FCUs. Chiller data not trended, mfr cutsheet used.		
Measure:	Schedule FCUs through existing BAS system.		
Recommendation for Implementation:	Schedule FCUs 1, 2, 3, 4, 5, 6, and 7 to be off all day. They will turn on for two hours a day to help keep humidity levels at acceptable levels and to circulate air so the building air quality will be acceptable. FCU-8 will operate from 7 AM to 10 AM Monday through Friday to assure the class within it will get acceptable air levels. The units will also initiate on if the space temperature is below occupied setpoint. During this time the OA dampers will remain closed and air will be re-circulated to maintain space temperature. When the FUCs are off the chilled water pumps will remain off as well due to them only supplying chilled water to these units. If the owner determines they cannot shut these units off during the school year because the building will be in use, this ECO cannot be implemented.		
Evidence of Implementation Method:	The following points will be trended for FCU-1, 2, 3, 4, 5, 6, 7, and 8 on the automation system to assure the they are scheduled properly. SF Status, OA damper, MAT, Space temperature, DAT, heat valve, and chilled water valve. These point will be trended during the winter months when the OAT is below 20 F to assure the spaces are maintaining space temperature and the unit follows the appropriate schedule. They will be trended during the cooling season as well to assure they are off when required. During the cooling season the chilled water pump status will be trended to assure they are off when all FCUs are off.		

Annual Electric Savings (kWh):	18,793	Annual Natural Gas Savings (therms):	467
Estimated Annual kWh Savings ($):	$1,306	Estimated Annual Natural Gas Savings ($):	$320
Contractor Cost ($):	$250		
PBEEEP Provider Cost for Implementation Assistance ($):	$0		
Total Estimated Implementation Cost ($):	$250		

Estimated Annual Total Savings ($):	$1,626	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.15	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.15	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	19	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	22.3%	Percent of Implementation Costs:	2.5%

Findings Details

Building: Mott Hall

FWB Number:	10933	Eco Number:	2
Site:	MN Academy of the Deaf Completion	Date/Time Created:	6/12/2012

Investigation Finding:	All Fan Coil units operate on schedule although campus is unoccupied during summer breaks	Date Identified:	2/20/2012
Description of Finding:	FCU-1, 2, 3, 4, 5, 6, 7, and 8 and the chilled water pumps are scheduled to operate during the summer break within Mott Hall. The schedule of these units can be reduced to generate savings.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Equipment is enabled regardless of need, or such enabling is excessive		

Implementer:	Operator	Benefits:	Energy Savings
Baseline Documentation Method:	Trended data for 3 of 8 FCUs. Schedules observed on BAS for remainder of FCUs. Chiller data not trended, mfr cutsheet used.		
Measure:	Schedule FCUs through existing BAS system.		
Recommendation for Implementation:	Schedule FCU 1, 2, 3, 4, 5, 6, 7, and 8 off during the summer break. All FCUs should turn on for 2 hours a day and operate under normal conditions to assure air quality in spaces and help maintain humidity levels. When the FCUs are off the chilled water pumps will remain off as well.		
Evidence of Implementation Method:	The following points will be trended for FCU-1, 2, 3, 4, 5, 6, 7, and 8 on the automation system to assure the they are scheduled properly. SF Status, OA damper, MAT, Space temperature, DAT, heat valve, and chilled water valve. They will be trended during the summer break to assure they are off when required. During the cooling season the chilled water pump status will be trended to assure they are off when all FCUs are off.		

Annual Electric Savings (kWh):	8,197	Peak Demand Savings (kWh):	18
Estimated Annual kWh Savings ($):	$570	Estimated Annual Demand Savings ($):	$483
Contractor Cost ($):	$250		
PBEEEP Provider Cost for Implementation Assistance ($):	$0		
Total Estimated Implementation Cost ($):	$250		

Estimated Annual Total Savings ($):	$1,053	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.24	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.24	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	7	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	14.4%	Percent of Implementation Costs:	2.5%

Findings Summary

Building: Rodman Hall

Site: MN Academy of the Deaf Completion

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
3	FCU-2 operates during summer breaks. Schedule OFF when Rodman is not occupied in summer.	$100	$112	0.89	$0	0.89	1
2	ERU-1 operates during summer breaks. Schedule OFF during summer except for 2 weeks during summer sc	$840	$446	1.88	$0	1.88	3
1	ERU-1 operates 7 days a week. Schedule OFF during weekends.	$840	$217	3.87	$0	3.87	4
	Total for Findings with Payback 3 years or less:	**$940**	**$558**	**1.69**	**$0**	**1.69**	**4**
	Total for all Findings:	**$1,780**	**$775**	**2.30**	**$0**	**2.30**	**9**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Rodman Hall

FWB Number:	10934	Eco Number:	1
Site:	MN Academy of the Deaf Completion	Date/Time Created:	6/12/2012

Investigation Finding:	ERU-1 operates 7 days a week. Schedule OFF during weekends.	Date Identified:	2/20/2010
Description of Finding:	ERU-1 scheduled to operate from 4:45 am to 7:15 pm seven days a week although Rodman building is occupied only during the week. Compare cost of installing window AC unit to cool apartment . Apartment is heated with fin tube radiation.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Reset Schedules)
Finding Type:	Other Controls (Reset Schedules)		

Implementer:	Operator	Benefits:	Energy savings
Baseline Documentation Method:	Trend of ERU temperatures from winter to find unit effectiveness. This was applied to summer trends as discharge temp off energy recovery wheel was not trended in summer. Schedules for year found on automation system. Actual Amps measured at ERU for 80% and 100% VFD speed. Unit operates between 80 - 100% volume always.		
Measure:	Reduce runtime for ERU by scheduling only weekdays. Provide window AC unit for apartment and food storage area. Compare cost of new equipment with cost to run ERU during unoccupied times.		
Recommendation for Implementation:	Purchase 2 window AC units and reschedule ERU-1 off during weekends. During the school secession.		
Evidence of Implementation Method:	Trend runtime of ERU for reduced hours. Verify the schedule of the BAS is accurate within the automation system.. Trend space temperature in food storage and apartment areas. Trend other space temperatures to assure they are not becoming to warm or cold during unoccupied times on weekends.		

Annual Electric Savings (kWh):	5,137	Contractor Cost ($):	$740
Estimated Annual kWh Savings ($):	$217	PBEEEP Provider Cost for Implementation Assistance ($):	$100
		Total Estimated Implementation Cost ($):	$840

Estimated Annual Total Savings ($):	$217	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	3.87	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	3.87	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	4	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	3.0%	Percent of Implementation Costs:	8.4%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Rodman Hall

FWB Number:	10934	Eco Number:	2
Site:	MN Academy of the Deaf Completion	Date/Time Created:	6/12/2012

Investigation Finding:	ERU-1 operates during summer breaks. Schedule OFF during summer except for 2 weeks during summer sc	Date Identified:	2/20/2010
Description of Finding:	ERU-1 scheduled to operate from 4:45 am to 7:15 pm, seven days a week during summer months although campus is occupied only 2 weeks during the summer. Consider using a window AC unit in the apartment when occupied and another window AC unit in the food storage area, the only areas that needs to be cooled., rather than running the ERU.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Reset Schedules)
Finding Type:	Other Controls (Reset Schedules)		

Implementer:	Operator	Benefits:	Energy savings
Baseline Documentation Method:	Trending of ERU temperatures, fan speed, schedules found on BAS.		
Measure:	Reduce runtime for EFU1 by scheduling only during the school year plus 2 weeks of summer school.		
Recommendation for Implementation:	Purchase 2 window AC units and reschedule ERU-1 off during summer breaks except 2 weeks of summer school.		
Evidence of Implementation Method:	Trend runtime of ERU for reduced hours. Verify the schedule of the BAS is accurate within the automation system.. Trend space temperature in food storage and apartment areas. Trend other space temperatures to assure they are not becoming to warm or cold during unoccupied times on weekends.		

Annual Electric Savings (kWh):	4,016	Contractor Cost ($):	$740
Estimated Annual kWh Savings ($):	$253	PBEEEP Provider Cost for Implementation Assistance ($):	$100
		Total Estimated Implementation Cost ($):	$840

Estimated Annual Total Savings ($):	$446	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	1.88	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	1.88	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	3	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	6.1%	Percent of Implementation Costs:	8.4%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Rodman Hall

FWB Number:	10934	Eco Number:	3
Site:	MN Academy of the Deaf Completion	Date/Time Created:	6/12/2012

Investigation Finding:	FCU-2 operates during summer breaks. Schedule OFF when Rodman is not occupied in summer.	Date Identified:	2/20/2010
Description of Finding:	FCU-2 scheduled to operate M-F, 3 am to 7 pm, 12 months of the year. It is cooling a kitchen area.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Reset Schedules)
Finding Type:	Other Controls (Reset Schedules)		

Implementer:	Operator	Benefits:	Energy savings
Baseline Documentation Method:	Trending of space temperatures, schedules found on BAS, unit enable trend		
Measure:	FCU operates to cool kitchen during summer breaks. Schedule unit OFF during summer breaks except 2 weeks of summer school.		
Recommendation for Implementation:	Schedule FCU-2 off during summer breaks except 2 weeks of summer school.		
Evidence of Implementation Method:	Trend FCU fan command, heat valve, cooling valve, damper %, space temperature, and DAT for the period of time the unit is specified to be unoccupied.		

Annual Electric Savings (kWh):	850	Contractor Cost ($):	$100
Estimated Annual kWh Savings ($):	$52	PBEEEP Provider Cost for Implementation Assistance ($):	$0
		Total Estimated Implementation Cost ($):	$100

Estimated Annual Total Savings ($):	$112	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.89	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.89	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	1	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.5%	Percent of Implementation Costs:	1.0%

Investigation Checklist

PBEEEP State Government

Rev. 2.0 (12/16/2010)

10931 - Smith Hall

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive			Investigation looked for, but did not find this issue.	Equipment is scheduled to match classroom schedule - 6 am to 3:45 pm
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	all equipment			All equipment is scheduled to run the same schedule year round although students are not on campus in the summer. Reduced runtime will be investigated
	a.3 (3)	Lighting is on more hours than necessary.			Not Relevant	Smith lighting not included in study
	a.4 (4)	OTHER_Equipment Scheduling/Enabling			Investigation looked for, but did not find this issue.	All equipment is very tightly scheduled during the school year -- off as soon as class is over. Equipment continues with the same schedule during summer months although campus is unoccupied except for 2 weeks of summer school.
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)			Investigation looked for, but did not find this issue.	AHU3 and 4 operate together, AHU3 economizing around 70F. AHU5 operates to make up hood exhaust and therefore does not economize
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.			Investigation looked for, but did not find this issue.	
	b.3 (7)	OTHER_Economizer/OA Loads			Investigation looked for, but did not find this issue.	
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive			Investigation looked for, but did not find this issue.	
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement			Investigation looked for, but did not find this issue.	
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints	VAV DD-9		Not cost-effective to investigate	Dual duct box VAV-9: When cooling setpoint deadband is exceeded (ie, space temp drops below 70F) rather than dropping cooling cfm below 700 cfm, heating is called for, heating damper opens, and then cfm drops to heating cfm (200 cfm.) When Tstat is satisfied, box goes back to cooling cfm. This happened very rarely, but it brought on the fan in AHU-4 because heat was called for. Fan came on only 5.4% of the time in May, 1.8% of time in June , so this is a very rare occurance. Try changing cooling minimum cfm to equal heating minimum cfm. Because this happened so rarely, no savings was calculated.
	c.4 (11)	OTHER_Controls			Investigation looked for, but did not find this issue.	
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.			Not Relevant	
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.			Investigation looked for, but did not find this issue.	
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently			Investigation looked for, but did not find this issue.	
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently			Not Relevant	Pumps are located in Quinn
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary	VAV-DD-9			See c.3.(10) above. This was not found on the other boxes trended in Smith.
	d.6 (17)	Other_Controls (Setpoint Changes)			Not Relevant	
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal			Not Relevant	SP setpoint =1.0 on AHU-3 and AHU-4
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.6 (22)	Other_Controls (Reset Schedules)			Investigation looked for, but did not find this issue.	

PBEEEP State Government

Rev. 2.0 (12/16/2010)

10931 - Smith Hall

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Not Relevant	
	f.2 (24)	Pump Discharge Throttled			Not Relevant	
	f.3 (25)	Over-Pumping			Not Relevant	
	f.4 (26)	Equipment is oversized for load.			Investigation looked for, but did not find this issue.	
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction			Not Relevant	
g. Variable Frequency Drives (VFD):	g.1 (28)	VFD Retrofit - Fans			Not Relevant	
	g.2 (29)	VFD Retrofit - Pumps			Not Relevant	
	g.3 (30)	VFD Retrofit - Motors (process)			Not Relevant	
	g.4 (31)	OTHER_VFD			Not Relevant	
h. Retrofits:	h.1 (32)	Retrofit - Motors			Not Relevant	
	h.2 (33)	Retrofit - Chillers			Not Relevant	
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)			Not Relevant	
	h.4 (35)	Retrofit - Boilers			Not Relevant	
	h.5 (36)	Retrofit - Packaged Gas fired heating			Not Relevant	
	h.6 (37)	Retrofit - Heat Pumps			Not Relevant	
	h.7 (38)	Retrofit - Equipment (custom)			Not Relevant	
	h.8 (39)	Retrofit - Pumping distribution method			Not Relevant	
	h.9 (40)	Retrofit - Energy/Heat Recovery			Not Relevant	
	h.10 (41)	Retrofit - System (custom)			Not Relevant	
	h.11 (42)	Retrofit - Efficient Lighting			Not Relevant	
	h.12 (43)	Retrofit - Building Envelope			Not Relevant	
	h.13 (44)	Retrofit - Alternative Energy			Not Relevant	
	h.14 (45)	OTHER_Retrofit			Not Relevant	
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard			Not Relevant	
	i.2 (47)	Impurity/Contamination			Not Relevant	
	i.3 ( )	Leaky/Stuck Damper			Not Relevant	
	i.4 ( )	Leaky/Stuck Valve			Not Relevant	
	i.5 (48)	OTHER_Maintenance			Not Relevant	
j. OTHER	j.1 (49)	OTHER			Not Relevant	

Investigation Checklist

PBEEEP State Government

Rev. 2.0 (12/16/2010)

10932 - Quinn Hall

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	Equipment runs when building is unoccupied	AHU-1		
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	Equipment runs during summer breaks	All AHUs and Efs		
	a.3 (3)	Lighting is on more hours than necessary.			Not Relevant	lighting not included in study
	a.4 (4)	OTHER_Equipment Scheduling/Enabling			Investigation looked for, but did not find this issue.	
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)	AHU-1			Mixed air setpoint is 64F. DAT setpoint is 60F. Chilled water is used to cool DAT to 60 when OA could be used.
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.			Investigation looked for, but did not find this issue.	
	b.3 (7)	OTHER_Economizer/OA Loads				
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive			Investigation looked for, but did not find this issue.	
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement			Investigation looked for, but did not find this issue.	
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints				
	c.4 (11)	OTHER_Controls	AHU-1 heating and cooling valves.	AHU-1	Not cost-effective to investigate	AHU-1 heating valve modulates in summer although heating is not available in summer. This does not happen with heating valve at AHU-2. MAT setpoint at AHU-1 is 64F. DAT setpoint is 60F. Chilled water valve at AHU-1 modulates to 100% when MAT>60 but chilled water is
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.			Not Relevant	
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.			Investigation looked for, but did not find this issue.	
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently			Investigation looked for, but did not find this issue.	
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently			Not cost-effective to investigate	Chilled water pumps run nearly continuously as chiller stages on/off to meet load, but are only 1.6 BHP and have VFDs. Shutting off AHUs during unocc hours will save more energy. Total annual cost per CHW pump is about $200.
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary			Investigation looked for, but did not find this issue.	
	d.6 (17)	Other_Controls (Setpoint Changes)			Investigation looked for, but did not find this issue.	
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	Chillers have 4 stages and operate mostly at 25% capacity.
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal				Cold deck setpoint is 60F and this meets all summer loads. Hot deck temp resets from 65 upward to meet heating load.
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal	AHU-1 and AHU-2 setpoint = 2.0"			
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	air cooled chiller, 4 stages
	e.6 (22)	Other_Controls (Reset Schedules)			Investigation looked for, but did not find this issue.	
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Not Relevant	
	f.2 (24)	Pump Discharge Throttled			Investigation looked for, but did not find this issue.	
	f.3 (25)	Over-Pumping			Investigation looked for, but did not find this issue.	

PBEEEP State Government

Rev. 2.0 (12/16/2010)

10932 - Quinn Hall

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
	f.4 (26)	Equipment is oversized for load.			Not cost-effective to investigate	Chiller maximum loading is about 60%
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction			Investigation looked for, but did not find this issue.	
g. Variable Frequency Drives (VFD):	g.1 (28)	VFD Retrofit - Fans			Not Relevant	VFDs on al motors
	g.2 (29)	VFD Retrofit - Pumps			Not Relevant	
	g.3 (30)	VFD Retrofit - Motors (process)			Not Relevant	
	g.4 (31)	OTHER_VFD			Not Relevant	
h. Retrofits:	h.1 (32)	Retrofit - Motors			Not Relevant	premium motors on all pumps and fans.
	h.2 (33)	Retrofit - Chillers			Not Relevant	
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)			Not Relevant	
	h.4 (35)	Retrofit - Boilers			Not Relevant	
	h.5 (36)	Retrofit - Packaged Gas fired heating			Not Relevant	
	h.6 (37)	Retrofit - Heat Pumps			Not Relevant	
	h.7 (38)	Retrofit - Equipment (custom)			Not Relevant	
	h.8 (39)	Retrofit - Pumping distribution method			Not Relevant	
	h.9 (40)	Retrofit - Energy/Heat Recovery			Not Relevant	
	h.10 (41)	Retrofit - System (custom)			Not Relevant	
	h.11 (42)	Retrofit - Efficient Lighting			Not Relevant	
	h.12 (43)	Retrofit - Building Envelope			Not Relevant	
	h.13 (44)	Retrofit - Alternative Energy			Not Relevant	
	h.14 (45)	OTHER_Retrofit			Not Relevant	
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard			Not Relevant	
	i.2 (47)	Impurity/Contamination			Not Relevant	
	i.3 ( )	Leaky/Stuck Damper			Not Relevant	
	i.4 ( )	Leaky/Stuck Valve			Not Relevant	
	i.5 (48)	OTHER_Maintenance			Not Relevant	
j. OTHER	j.1 (49)	OTHER			Not Relevant	

Investigation Checklist

PBEEEP State Government

Rev. 2.0 (12/16/2010)

10933 - Mott Hall

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	all FCUs			FCUs scheduled for occupied hours although building is mostly unoccupied.
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	all FCUs			FCUs scheduled for occupied hours although building is mostly unoccupied.
	a.3 (3)	Lighting is on more hours than necessary.			Investigation looked for, but did not find this issue.	lights were OFF every time I visited the facility.
	a.4 (4)	OTHER_Equipment Scheduling/Enabling			Investigation looked for, but did not find this issue.	shop exhaust fans only on when classes occupied (ie, never when I visited.) MAU scheduled to step up as Efs come on.
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)			Not cost-effective to investigate	FCU-8 OA damper stuck sometimes, not always, difficult to calculate effect. However this unit will be scheduled OFF most hous so finding is not cost effective.
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.			Investigation looked for, but did not find this issue.	OA % very low, in most cases 10% at minium.
	b.3 (7)	OTHER_Economizer/OA Loads			Investigation looked for, but did not find this issue.	
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive			Investigation looked for, but did not find this issue.	
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement			Investigation looked for, but did not find this issue.	
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints			Not cost-effective to investigate	FCU chilled water valves in some cases modulate 0 -100%, could be fine tuned but these FCU's will be scheduled off as building is mostly unoccupied.
	c.4 (11)	OTHER_Controls				
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.			Not Relevant	
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.			Investigation looked for, but did not find this issue.	
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently			Investigation looked for, but did not find this issue.	CV FCUs
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently			Not Relevant	CHW pumps not trended, HGA took over in October
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary			Not Relevant	
	d.6 (17)	Other_Controls (Setpoint Changes)				
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal			Not Relevant	
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.6 (22)	Other_Controls (Reset Schedules)			Not Relevant	
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Not Relevant	
	f.2 (24)	Pump Discharge Throttled			Not Relevant	
	f.3 (25)	Over-Pumping			Not Relevant	
	f.4 (26)	Equipment is oversized for load.			Investigation looked for, but did not find this issue.	
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction			Not Relevant	

PBEEEP State Government

Rev. 2.0 (12/16/2010)

10933 - Mott Hall

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	g.1 (28)	VFD Retrofit - Fans			Not Relevant	less than 3 hp at all FCU's. MAU has step control based on #EFs running.
	g.2 (29)	VFD Retrofit - Pumps			Not Relevant	
	g.3 (30)	VFD Retrofit - Motors (process)			Not Relevant	
	g.4 (31)	OTHER_VFD			Not Relevant	
h. Retrofits:	h.1 (32)	Retrofit - Motors			Not Relevant	
	h.2 (33)	Retrofit - Chillers			Not Relevant	
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)			Not Relevant	
	h.4 (35)	Retrofit - Boilers			Not Relevant	
	h.5 (36)	Retrofit - Packaged Gas fired heating			Not Relevant	
	h.6 (37)	Retrofit - Heat Pumps			Not Relevant	
	h.7 (38)	Retrofit - Equipment (custom)			Not Relevant	
	h.8 (39)	Retrofit - Pumping distribution method			Not Relevant	
	h.9 (40)	Retrofit - Energy/Heat Recovery			Not Relevant	
	h.10 (41)	Retrofit - System (custom)			Not Relevant	
	h.11 (42)	Retrofit - Efficient Lighting			Not cost-effective to investigate	Facility is in the process of changing these fixtures to T8s so calc was performed to evaluate savings for remaining fixtures. Lighting is on so few hours that savings is very low.
	h.12 (43)	Retrofit - Building Envelope			Not Relevant	
	h.13 (44)	Retrofit - Alternative Energy			Not Relevant	
	h.14 (45)	OTHER_Retrofit			Not Relevant	
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard			Not Relevant	
	i.2 (47)	Impurity/Contamination			Not Relevant	
	i.3 ( )	Leaky/Stuck Damper			Not cost-effective to investigate	OA damper at FCU-8, see note above
	i.4 ( )	Leaky/Stuck Valve			Not Relevant	
	i.5 (48)	OTHER_Maintenance			Not Relevant	
j. OTHER	j.1 (49)	OTHER			Not Relevant	

Investigation Checklist

PBEEEP State Government

Rev. 2.0 (12/16/2010)

10934 - Rodman Hall

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive			Investigation looked for, but did not find this issue.	Units are scheduled to match hourly occupied schedules
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	FCU-1,2 and ERU-1			Units are scheduled for weekends and summer break when building is not occupied
	a.3 (3)	Lighting is on more hours than necessary.			Not Relevant	Lighting not included in this building
	a.4 (4)	OTHER_Equipment Scheduling/Enabling	VAV's and Exhaust fans		Not cost-effective to investigate	Toilet exhaust fan fractional HP, Kitchen hood rarely used. VAV schedules are reversed in 2 of the the VAVs which were trended (VAV2 and VAV5), ie, max cfm during night times and minimum CFM during daytimes. This may be the correct schedule for VAV7 serving the apartment. VAV7 set for constant max OA. Finding will look at shutting down the ERU completely so this was not examined as a separate finding.
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)			Investigation looked for, but did not find this issue.	
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.			Investigation looked for, but did not find this issue.	
	b.3 (7)	OTHER_Economizer/OA Loads			Investigation looked for, but did not find this issue.	
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive			Investigation looked for, but did not find this issue.	
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement			Investigation looked for, but did not find this issue.	
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints			Investigation looked for, but did not find this issue.	
	c.4 (11)	OTHER_Controls			Investigation looked for, but did not find this issue.	
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.			Not Relevant	Lighting not included in this building
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.			Not cost-effective to investigate	See line 11 re: VAVs
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently			Investigation looked for, but did not find this issue.	
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently			Not cost-effective to investigate	Pump speeds vary little. The pumps are only 3 HP. Finding will look at shutting down AHUS during non-occupied hours which will result in more savings than optimizing this VFD.
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary			Not cost-effective to investigate	VAV7 serving apartment min cfm is 100 cfm OA, which is higher than requried for one person. Finding will look at separating this area from the ERU rather than reducing the flow from ERU1. This area could be rebalanced to lower cfm based on occupancy of one person.
	d.6 (17)	Other_Controls (Setpoint Changes)			Investigation looked for, but did not find this issue.	
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	boiler not included in this study.
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Not Relevant	summer trends for this chiller included only start/stop.
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.6 (22)	Other_Controls (Reset Schedules)			Investigation looked for, but did not find this issue.	
	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Not Relevant	

PBEEEP State Government

Rev. 2.0 (12/16/2010)

10934 - Rodman Hall

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
f. Equipment Efficiency Improvements / Load Reduction:	f.2 (24)	Pump Discharge Throttled			Investigation looked for, but did not find this issue.	
	f.3 (25)	Over-Pumping			Investigation looked for, but did not find this issue.	
	f.4 (26)	Equipment is oversized for load.			Not Relevant	no loading info available from summer trends
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction			Investigation looked for, but did not find this issue.	
g. Variable Frequency Drives (VFD):	g.1 (28)	VFD Retrofit - Fans			Not Relevant	
	g.2 (29)	VFD Retrofit - Pumps			Not Relevant	
	g.3 (30)	VFD Retrofit - Motors (process)			Not Relevant	
	g.4 (31)	OTHER_VFD			Not Relevant	
h. Retrofits:	h.1 (32)	Retrofit - Motors			Not Relevant	
	h.2 (33)	Retrofit - Chillers			Not Relevant	
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)				window Acs for apartment and food storage area will be compared to running ERU during unoccupied times
	h.4 (35)	Retrofit - Boilers			Not Relevant	
	h.5 (36)	Retrofit - Packaged Gas fired heating			Not Relevant	
	h.6 (37)	Retrofit - Heat Pumps			Not Relevant	
	h.7 (38)	Retrofit - Equipment (custom)			Not Relevant	
	h.8 (39)	Retrofit - Pumping distribution method			Not Relevant	
	h.9 (40)	Retrofit - Energy/Heat Recovery			Not Relevant	
	h.10 (41)	Retrofit - System (custom)			Not Relevant	
	h.11 (42)	Retrofit - Efficient Lighting			Not Relevant	
	h.12 (43)	Retrofit - Building Envelope			Not Relevant	
	h.13 (44)	Retrofit - Alternative Energy			Not Relevant	
	h.14 (45)	OTHER_Retrofit			Not Relevant	
i. Maintenance Related Problems:	i.1 (46)	Differed Maintenance from Recommended/Standard			Not Relevant	
	i.2 (47)	Impurity/Contamination			Not Relevant	
	i.3 ( )	Leaky/Stuck Damper			Investigation looked for, but did not find this issue.	
	i.4 ( )	Leaky/Stuck Valve			Investigation looked for, but did not find this issue.	
	i.5 (48)	OTHER_Maintenance			Investigation looked for, but did not find this issue.	
j. OTHER	j.1 (49)	OTHER			Investigation looked for, but did not find this issue.	

Architecture | Engineering | Planning

April 30, 2012

WRITER'S DIRECT DIAL 612-758-4660

Mr. Randy Dirks
Physical Plant Director
Minnesota State Academy for the Deaf
615 Olof Hanson Drive
Faribault, Minnesota 55021

Re: Minnesota State Academy for the Deaf - PBEEEP Investigation
HGA Commission Number 0476-048-00

Dear Mr. Dirks:

Hammel, Green and Abrahamson, Inc. has completed the energy investigation of the MSAD facility, identifying the following energy-saving opportunities:

Static Pressure Setpoint, Quinn Hall AHU-1 and AHU-2:
The current static pressure setpoint of 2.0" is higher than required for the operation of the VAV terminal units. Trending showed that the fans operated at 90% speed or greater only 7% of the time during peak months. This calculation assumes that the VAVs could operate at a static pressure setpoint of 1.0" for 90% of the operating hours and at 1.5" static pressure for the remaining 10% of operating hours. In order to reset automatically to a higher setpoint when any VAV zone is 100% open and not satisfying setpoint, a modification to the existing control sequence is required.

Operating Schedules:
The MSAD campus has already made great use of the scheduling capabilities of the existing BAS system. The equipment is scheduled to closely match classroom operation. Savings will be achieved by scheduling all equipment off during summer hours. The calculation assumes that the equipment will be operated for 2 hours per night to ventilate and dehumidify the spaces.

Trend data showed that AHU-1 in Quinn Hall operates at 50% speed even when the automation sequence calls for it to be off. Exhaust fans also run during unoccupied hours. This programming error should be investigated by the System One service contractor.

Mott Hall fan coil units operate on the same classroom schedule as other buildings, although the building is unoccupied except for the large engines classroom for 1 class per day. The calculation assumes that all equipment, except for FCU-8, will operate for 2 hours per night to ventilate and dehumidify the spaces. The single classroom still in use was assumed occupied for 3 hours per day during weekdays.

Lighting Retrofit in Mott Hall:
Upgrading the lights in Mott Hall to T8 fixtures is already in progress. This calculation shows that there is a 5.2 year payback on the investment of the remaining 100 fixtures, even with the assumed 3 hours per day of occupancy in Mott Hall.

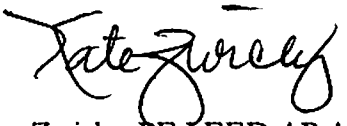
In addition to the findings shown in the final report, the following observations were made which could also lead to additional energy savings.

Cabinet Unit Heater Setpoints:
Cabinet unit heaters are currently set to heat vestibules to 70° Fahrenheit during occupied times and 60° Fahrenheit during unoccupied times. CUH-1 in Quinn and all CUHs in Smith are overridden to occupied, maintaining a space temp of 70° Fahrenheit. These units serve unoccupied spaces. Reducing the setpoints to 50° Fahrenheit during unoccupied times and 60° Fahrenheit during occupied times is reasonable for unoccupied spaces.

Valence Cooling Units
Rodman Hall valence units were not included in this study. The recommendation to shut down the ERU and FCUs in Rodman during unoccupied times would be increased by also disabling the valence cooling units, or increasing the unoccupied cooling setpoint to 80° Fahrenheit during unoccupied times.

Please contact me directly with any questions at 612-758-4660 or KZwicky@hga.com.

Sincerely,



Kate Zwicky, PE LEED AP ASHRAE HFDP QCxP
Senior Associate
Mechanical Department

cc: Chris Plum, CEE
Neal Ray, CEE
Doug Maust, HGA

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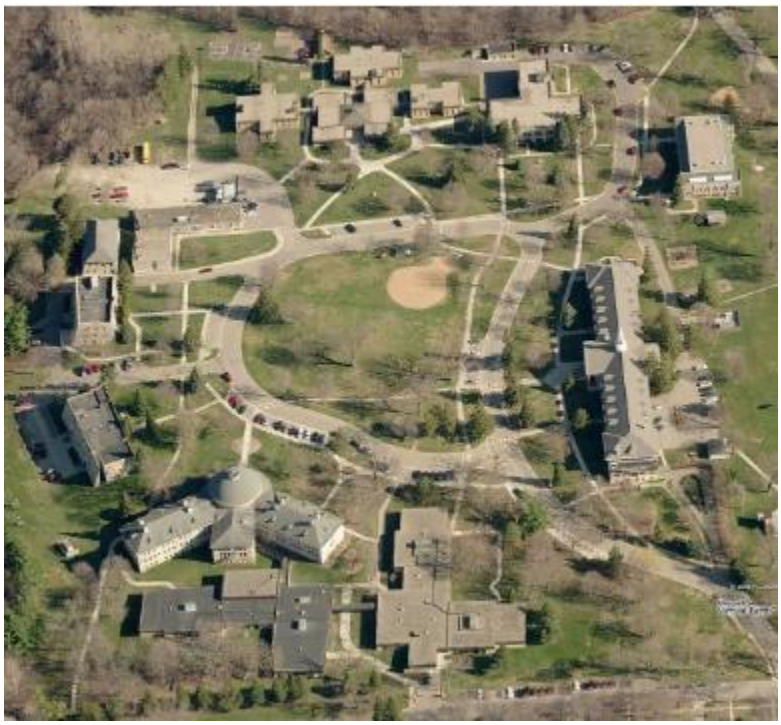
PBEEEP
State Government

Public Buildings Enhanced Energy Efficiency Program

SCREENING RESULTS FOR MINNESOTA ACADEMIES DEAF CAMPUS

MSAD

Date: 4/27/10



Summary Table

Facility Name	MN Academies Deaf Campus
Location	615 Olof Hanson Drive, Faribault, MN 55021
Facility Manager	Randy Dirks
Number of Buildings	13
Interior Square Footage	314,401
PBEEEP Provider	CEE (Neal Ray)
State's Project Manager	Randy Dirks, Physical Plant Director
Date Visited	January 13, 2010 and February 1, 2010
Annual Energy Cost	$289,715
Utility Company	Xcel Energy (Gas and Electric)
Site Energy Use Index (EUI)	93 kBtu/ft^2
Benchmark EUI (form B3)	115.9 kBtu/ft^2

Recommendation for Investigation

This facility consists of 13 buildings. Of the 13 buildings 7 of the buildings (218,351 ft^2) are good candidates for investigation and the remaining 6 buildings (96,050 ft^2) are poor candidates for investigation.

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Building Name	State ID	Area (Square Feet)	Year Built
Smith Hall	E4400101966	25,341	1973
Quinn Hall	E4400102166	22,175	1971
Mott Hall	E4400102866	13,769	1926
Rodman Hall	E4400101766	22,603	1923
Power Plant	E4400100866	18,061	1958
Noyes Hall	E4400102766	54,195	1909
Lauritsen Gym	E4400102666	25,690	1931
Tate Hall	E4400100966	62,207	1913
Frenchette Hall	E4400101466	43,630	1967
Garage	E4400103166	1,926	1923
Laundry Building	E4400100766	7,100	1926
Pollard Hall	E4400101266	16,746	1937
Scout Cabin	E4400102066	958	1973

Minnesota Academies Deaf Campus Screening Overview

The goal of screening is to select buildings where an in-depth energy investigation can be performed to identify energy saving opportunities that will generate savings with a relatively fast (1 to 5 years) and certain payback. The screening of the Minnesota Academies Deaf Campus was performed by the Center for Energy and Environment (CEE) with the assistance of the facility staff. This report is the result of that information.

The Minnesota Academies Deaf Campus is made up of 13 buildings totaling 314,401 gross square feet. The buildings were all constructed between 1909 and 1973. There have been several mechanical upgrades during the history of the facility.

Overall there are 3 boilers, 5 chillers, 15 AHUs, 12 hot water pumps, 10 chilled water pumps, 117 FCUs, 1 ERU, and 1 MAU. Areas of all the building which do not receive heat directly from the AHUs are primarily heated by finned tube radiation. The steam is generated by the power plant on campus.

Four of the buildings which total 83,890 ft^2 are either fully automated or almost completely automated on a Talon system by Siemens. Noyes building contains an AHU and FCU which are on the automation system; the rest of the building is not automated.

The power plant is also not on the automation system, but contains the boilers which supply steam to the entire campus. This equipment would be important to include in an energy study.

Tate Hall, Lauritsen Gym, and Frenchette Hall contain a large amount of mechanical equipment but are not on an automation system and mostly run on individual pneumatic controls. Noyes building also contains a large amount of equipment which is controlled by pneumatics. These buildings range is sizes from 25,000 ft^2 to 62,000 ft^2. Frenchette Hall is scheduled to be demolished within three to four years. It is therefore less likely to find cost-effective energy conservation opportunities in this building.

There are also four smaller buildings which consist of a total of 26,730 ft^2 which have limited mechanical equipment and are not on any type of automation system. These are poor candidates for investigation.

The campus contains two electrical meters, one interruptible gas meter, and one firm gas meter. None of the buildings utilities are sub-metered.

PBEEEP Screening Report of Minnesota Academies Deaf Campus PBEEEP # P10900

This screening report is based on the PBEEEP Guidelines. It is the product of two site visits, review of the facility documentation and BAS, a limited inspection of the facility and interviews with the staff. The purpose of the screening report is to evaluate the potential of the facility for the implementation of cost-effective energy efficiency savings through retrocommissioning. To the best of our knowledge the information here is accurate. It provides a high level view of many, but by no means all, of the important parameters of the mechanical equipment in the facility. Because it is the result of a limited audit survey of the facility, it may not be completely accurate.

Good Candidates for Investigation

Seven buildings totaling 218,351 ft^2 are good candidates for investigation. In general, they are moderate in size, have at least one central air handling unit and most of the equipment is either associated with a building automation system (Talon by Siemens) or controlled by pneumatics. Most of these buildings were renovated with new HVAC equipment in the last ten years but not commissioned. All buildings share the same central boiler plant for heat.

These seven buildings have a total of 9 AHUs, 1 MAU, 1 ERU, 5 chillers, 117 FCUs, and, a central boiler plant with a total of three boilers. The tables below describe what equipment is automated and what points are on the BAS. A large portion of the buildings' equipment is automated. The power plant is not automated, but is recommended for investigation because the boilers supply heat to the whole campus. Tate and Noyes Hall are also recommend for investigation due to the large amount of mechanical equipment in the buildings. All facility buildings are individual buildings and not connected. If it is not specified in the table the buildings contain T8 lights.

Potential Energy Savings Opportunities:
Some potential energy saving opportunities noted while screening were:

- shutting down equipment during summer vacation and holiday breaks
- cooling and heating pump interactions
- lighting upgrades
- Automating equipment which is not automated
- possible boiler upgrades

Smith Hall		State Building ID# E4400101966			
Area (sqft)	25,341	Year Built	1973	Occupancy (hrs/yr)	2,000

HVAC Equipment

- 3 AHUs

AHU-3	12,000 CFM	20 HP	VAV	VFD with 22 dual duct VAV boxes.
AHU-4	10,000 CFM	20 HP	VAV	VFD with 22 dual duct VAV boxes.
AHU-5	1,000 CFM	5 HP	CV	For science classroom

- **Note:** AHU-3 and AHU-4 serve the same spaces. AHU-3 supplies to the cold duct of the 22 dual duct VAV boxes and AHU-4 supplies air to the hot duct of the 22 dual duct VAV boxes

- 6 CUHs and 1 UH, each rated at 30 kBtu/hr
- 8 Exhaust fans all rated between 120 and 1550 CFM
- 1 large relief fan rated at 10,000 CFM

Points on BAS

- **AHU**: heat valve, HWST, HW coil DP, chilled water valve, CHWST, CHW coil DP, DAT, MAT, RAT, OAT, econ dampers, return dampers, exhaust dampers, duct static, fan status, supply and exhaust fan speed, space pressure, DAT setpoint, duct static setpoint, supply air CFM, OA CFM, RA CFM, EA CFM

- **VAV**: damper position (cooling and heating damper), space temperature, space temperature setpoint (occupied and unoccupied), CFM, cooling CFM setpoint, heating CFM setpoint, heating demand, cooling demand, perimeter heating valve

- **CUH**: Space temperature, space temperature setpoint (occupied and unoccupied), heating valve

Quinn Hall		State Building ID# E4400102166			
Area (sqft)	22,175	Year Built	1971	Occupancy (hrs/yr)	2,000

HVAC Equipment

- 1 Chiller rated at 103 tons
- 2 AHUs

AHU-1	12,000 CFM	20 HP	VAV	VFD with 21 dual duct VAV boxes.
AHU-2	10,000 CFM	20 HP	VAV	VFD with 21 dual duct VAV boxes.

- **Note:** AHU-1 and AHU-2 serve the same spaces. AHU-1 supplies to the cold duct of the 22 dual duct VAV boxes and AHU-2 supplies air to the hot duct of the 22 dual duct VAV boxes
- 4 secondary hot water pumps two rated at 5 HP and two rated at 1.5 HP.(Two pumps supply hot water for Smith Hall and two pumps supply hot water for this building)
- 2 Chilled water pumps rated at 2 HP.
- 5 CUHs and 1 UH each rated at 30 kBtu/hr
- 8 Exhaust fans all rated between 85 and 1200 CFM
- 1 large relief fan rated at 10,000 CFM.

Points on BAS

- **AHU**: heat valve, HWST, hot water coil DP, chilled water valve, CHWST, chilled water coil DP, DAT, MAT, RAT, OAT, econ dampers, return dampers, exhaust dampers, duct static, supply and exhaust fan status, supply and exhaust fan speed, space pressure, DAT setpoint, duct static setpoint, supply air CFM, OA CFM, RA CFM, EA CFM
- **VAV**: damper position (cooling and heating damper), space temperature, space temperature setpoint (occupied and unoccupied), CFM, cooling CFM setpoint, heating CFM setpoint, heating demand, cooling demand, perimeter heating valve
- **CUH**: Space temperature, space temperature setpoint (occupied and unoccupied), heating valve
- **Heat Pump and HX**: 2/3 valve, 1/3 valve, HWST, HWST setpoint, hot water pump VFD speed, Smith building DP, Quinn building DP
- **Chiller**: condenser pressure, evaporator pressure, chiller enable, chiller command, cooling demand from AHUs, capacity, load, CHWST, pump differential pressure, pump status, pump speed

Mott Hall		State Building ID# E4400102866			
Area (sqft)	13,769	Year Built	1926	Occupancy (hrs/yr)	2,000

HVAC Equipment

- 1 Chiller rated at 60 tons
- 8 Fan coil units rated between 1,000 to 4,000 CFM
- 1 MAU delivering 13,050 CFM
- 10 Exhaust Fans rated between 500 to 10,000 CFM
- 2 chilled water pumps rated at 150 gpm and 7.5 HP
- Existing lighting is T12

Points on BAS

- **FCU**: heating valve, cooling valve, SF status, MAT, DAT, OAT, space temperature, space temperature setpoint (occupied and unoccupied), OA damper, RA damper, EA damper, space pressure, space pressure setpoint.

- **MAU**: heating valve, face bypass damper, SF status, SF speed, DAT, OAT, welding booths supply air damper, spray booth supply air damper, welding booth #1 EF command and exhaust damper, welding booth #2 EF command and exhaust damper, spray booth EF command and exhaust damper, space pressure, space pressure setpoint

- **Chiller**: Command, command override, outside air temperature interlock, lead pump status, schedule to rotate lead pump, pump command, pump over ride command, CHWST, CHWRT

Rodman Hall		State Building ID# E4400101766			
Area (sqft)	22,603	Year Built	1923	Occupancy (hrs/yr)	2,000

HVAC Equipment

- 1 Chiller rated at 40 tons
- 1 ERU and 2 FCUs

ERU-1	3,000 CFM	5 HP	VAV	Contains a VFD supplies outside air to 7 VAV boxes
FCU-1	900 CFM	0.5 HP	CV	
FCU-2	2,200 CFM	1.5 HP	CV	

- 3 exhaust fans: 200 to 525 CFM
- 2 chilled water pumps rated at 52.5 gpm, 3 HP, VFD
- 29 valance units: cooling rating between 4.7 to 26.7 kBtu/hr
- 14 valves for FTR: rating between 10 to 40 kBtu/hr

Points on BAS

- **FCU**: OA and RA Damper, heating valve, cooling valve, low temp, DAT, DAT setpoint, fan status, occupancy, heating demand, cooling demand, space temperature, space temperature setpoint, heating and cooling occupied and unoccupied setpoints
- **VAV**: Occupancy sensor, occupied flow setpoint, unoccupied flow setpoint, resultant flow setpoint, actual CFM delivery, damper control
- **Chiller**: OAT, Chiller enable, chiller status, CHWST, CHWRT, pump DP, DP setpoint, VFD runtime, pump enable, frequency, current, speed
- ERU, exhaust fans, valance units, and FTR are not automated

Power Plant		State Building ID# E4400100866			
Area (sqft)	18,061	Year Built	1958	Occupancy (hrs/yr)	2,600

HVAC Equipment

- 2 Large Boilers: Maximum gas input of 16,000 kBut/hr. One boiler had a new burner installed in 1991 and the other one had a new burner installed in 1997.
- 1 Smaller boiler with a maximum fire rate of 8,370 kBtu/hr
- There are also several exhaust fans serving an industrial space within this building
- Finned tube radiation is used as the primary source of heat for occupants in office spaces.

Points on BAS

- None

Noyes Hall		State Building ID# E4400102766			
Area (sqft)	54,195	Year Built	1909	Occupancy (hrs/yr)	2,000

HVAC Equipment

- 1 Chiller rated at 100 tons
- 2 AHUs

AHU-1	2,100	5 HP	VAV	Contains a VFD supplies outside air to all fan coil units in west wing
AHU-2	8,000 CFM	15 HP	CV	Supplies auditorium

- 35 FCUs: rated between 260 to 1,950 CFM
- 3 exhaust fans: 200 to 525 CFM
- 2 chilled water pumps rated at 265 gpm and 7.5 HP
- 1 domestic hot water pump rated at 5 gpm, 1/6 HP
- 2 hot water pumps, no design information could be found on them

Points on BAS

- **AHU-2**: heating valve, cooling valve, SF status, SF speed, DAT, RAT, MAT, OAT, higher auditorium temperature, lower auditorium temperature, RA CO_2, RA humidity, OA damper, RA damper, EA damper, RF command, RF speed, return CFM, supply CFM, OA CFM, space pressure

- **FCU**: heat valve, cooling stages, damper position, return humidity, RAT, DAT, DAT setpoint, cooling demand, heating demand, space temperature, space temperature setpoint.

Tate Hall		State Building ID# E4400100966			
Area (sqft)	62,207	Year Built	1913	Occupancy (hrs/yr)	2,000

HVAC Equipment

- 1 Chiller rated at 104 tons
- 2 AHUs

  AHU-1 7,200 CFM 5 HP CV
  AHU-2 3,700 CFM 5 HP CV
- 72 Fan coil units between 240 and 1600 CFM
- 1 Primary chilled water pump rated at 7.5 HP with VFD
- 1 Secondary chilled water pump rated at 7.5 HP with VFD
- 2 Hot water pumps rated at 5 HP with VFD
- 2 Hot water pumps rated at 5 HP for fin tube radiation with VFD
- 11 unit heaters and cabinet unit heaters rated at 20 kBtu/hr
- 4 Exhaust fans rated between 1,000 to 2,000 CFM
- 2 steam to hot water heat exchangers rated at 100 gpm

Points on BAS

- None, runs on pneumatics

Poor Candidates for Investigation

Six buildings with a total of 96,050 ft^2 are not recommended for investigation. One of these buildings is scheduled to be demolished. The others have limited mechanical equipment which is not controlled by the building automation system. These recommendations are based off the mechanical equipment within the buildings. These buildings may still benefit from a lighting upgrade.

Lauritsen Gym			**State Building ID# E4400102666**		
Area (sqft)	25,690	Year Built	1931	Occupancy (hrs/yr)	2,600
HVAC Equipment					
- 2 AHUs up in attic unknown size, stated to be original with building. - FTR along perimeter is used for heat. - Existing lights in the building are T12.					
Points on BAS					
- None, runs on pneumatics					

Frenchette Hall			**State Building ID# E4400101466**		
Stated to be Demolished in 3 to 4 years					
Area (sqft)	43,630	Year Built	1967	Occupancy (hrs/yr)	2,000
HVAC Equipment					
- 4 AHUs Heating and Ventilating units 1-3 CV system with reheat duct coils Heating and Ventilating Unit 4 CV system with reheat duct coils - 39 Convectors and radiators - 39 duct reheat coil - 4 cabinet unit heaters - 3 underfloor heaters - 2 hot water pumps					
Points on BAS					
- None, runs on pneumatics. This building also contains its own compressor to run pneumatics in building					

Garage		State Building ID# E4400103166			
Area (sqft)	1,926	Year Built	1923	Occupancy (hrs/yr)	2,000
HVAC Equipment					
- 1 Gas Fired heating unit unknown capacity					
Points on BAS					
- Not on the automation system; works off thermostat on wall.					

Laundry Building		State Building ID# E4400100766			
Area (sqft)	7,100	Year Built	1926	Occupancy (hrs/yr)	Storage
HVAC Equipment					
- Old Cast Iron Finned Tube Radiation on perimeter is only source of heat					
Points on BAS					
- Not on the automation system; is based off space temperature.					

Pollard Hall		State Building ID# E4400101266			
Area (sqft)	16,746	Year Built	1937	Occupancy (hrs/yr)	2,000
HVAC Equipment					
- Whole building is only heated with finned tube radiation					
Points on BAS					
- None					

Scout Cabin		State Building ID# E4400102066			
Area (sqft)	958	Year Built	1973	Occupancy (hrs/yr)	2,000
HVAC Equipment					
- No record found of HVAC equipment.					
Points on BAS					
- None					

PBEEEP Abbreviation Descriptions			
AHU	Air Handling Unit	HW	Hot Water
BAS	Building Automation System	HWDP	Hot Water Differential Pressure
CDW	Condenser Water	HWRT	Hot Water Return Temperature
CDWRT	Condenser Water Return Temperature	HWST	Hot Water Supply Temperature
CDWST	Condenser Water Supply Temperature	kW	Kilowatt
CFM	Cubic Feet per Minute	kWh	Kilowatt-hour
CHW	Chilled Water	MA	Mixed Air
CHWRT	Chilled Water Return Temperature	MA Enth	Mixed Air Enthalpy
CHWST	Chilled Water Supply Temperature	MARH	Mixed Air Relative Humidity
CRAC	Computer Room Air Conditioner	MAT	Mixed Air Temperature
CV	Constant Volume	MAU	Make-up Air Unit
DA	Discharge Air	OA	Outside Air
DA Enth	Discharge Air Enthalpy	OA Enth	Outside Air Enthalpy
DARH	Discharge Air Relative Humidity	OARH	Outside Air Relative Humidity
DAT	Discharge Air Temperature	OAT	Outside Air Temperature
DDC	Direct Digital Control	Occ	Occupied
DP	Differential Pressure	RA	Return Air
DX	Direct Expansion	RA Enth	Return Air Enthalpy
EA	Exhaust Air	RARH	Return Air Relative Humidity
EAT	Exhaust Air Temperature	RAT	Return Air Temperature
Econ	Economizer	RF	Return Fan
EF	Exhaust Fan	RH	Relative Humidity
Enth	Enthalpy	RTU	Rooftop Unit
ERU	Energy Recovery Unit	SF	Supply Fan
FCU	Fan Coil Unit	Unocc	Unoccupied
FTR	Fin Tube Radiation	VAV	Variable Air Volume
HP	Horsepower	VFD	Variable Frequency Drive
HRU	Heat Recovery Unit	VIGV	Variable Inlet Guide Vanes

Conversions:
1 kWh = 3.412 kBtu
1 Therm = 100 kBtu
1 kBtu/hr = 1 MBH